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NOV - 8 1990

ENERGY $AVER$

"... For Business and Industry".

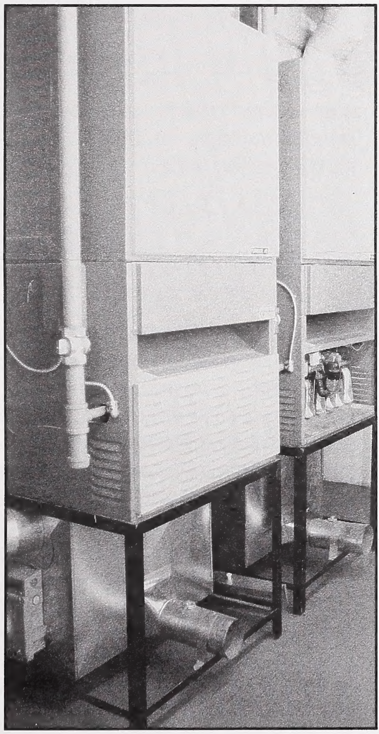
VOLUME ONE / NO. 6

TUNE-UP YOUR FURNACE AND SAVE

The Facts...

A combustion-efficient furnace can save building owners and operators money while maintaining comfortable living and working conditions.

Many smaller wood-frame and concrete-block buildings use forced air furnace systems for both ventilation and building heating, or for ventilation air only. These furnaces are found in most areas of the private sector and in public facilities.



A forced air furnace system.

In Alberta, most furnaces burn natural gas. The energy audit program conducted by staff of Alberta's Energy Buses has shown the potential for natural gas savings through improving combustion efficiency. A survey of furnace contractors indicates that, on average, there is potential for at least 10 per cent improvement in furnace efficiency. In many cases, savings can be achieved through relatively simple maintenance measures such as replacing dirty air filters, adjusting or replacing fan belts, or lubricating motors and fan bearings.

These preventative maintenance techniques can usually be carried out by regular maintenance staff as part of the normal work routine. More complex servicing, such as removing and cleaning heat exchangers and adjusting the pilot flame, may have to be done by specialists.

Combustion is the burning of a fuel and oxygen mixture to produce heat. For efficient furnace operation, and to provide a safety margin to prevent the formation of carbon monoxide, it is desirable to supply about 40 per cent more air (oxygen) than is needed in theory for combustion of the fuel. Combustion efficiency decreases as additional air is supplied.

There are two types of furnace efficiency – steady-state and seasonal. Steady-state combustion efficiency is defined as follows:

$$\text{Steady-State Combustion Efficiency} = 100\% \times \frac{\text{heat input} - \text{heat loss in chimney}}{\text{heat input}}$$

To measure steady-state efficiency, the furnace must be at its peak operating temperature.

Seasonal efficiency takes into account steady-state combustion efficiency as well as system losses. For example, with conventional furnaces, warm building air lost up the chimney can account for 12 to 15 per cent of fuel energy used. A continuously running pilot flame can consume five to seven per cent extra fuel during non-heating periods. Losses also occur during start-up before the furnace reaches maximum steady-state efficiency.

The conventional furnace is the most common type in Alberta. Normally, it will have a maximum steady-state efficiency of about 75 per cent, but the seasonal efficiency drops to 50 or 60 per cent. Although widely available, reliable and easy to repair, the conventional furnace has a lower seasonal efficiency than medium- and high-efficiency furnaces.

Medium-efficiency furnaces can achieve steady-state and seasonal efficiencies of about 80 per cent. These furnaces have features such as an electronic flame ignition that operates only when igniting the air/fuel mixture, and an induced draft fan or vent dampers that reduce the amount of warm room air that escapes via the chimney when the furnace is off.

High-efficiency furnaces incorporate features in addition to those of the standard medium-efficiency furnace. The most distinguishing is the condensing of the water vapor in the flue gas within a separate heat exchanger to recover latent heat (the heat released when water vapor changes from a gas to a liquid). Steady-state efficiency can range from 89 to 97 per cent while seasonal efficiency is in the 85 to 94 per cent range.

For all types of furnaces, a number of simple steps to improve efficiency can be done by building operators as part of regular maintenance. For example, operators with the appropriate technical background can: 1) clean burners; 2) adjust fan speed to achieve manufacturer's specified air temperature rise; 3) adjust primary air shutters for proper air/fuel mixture; 4) check to see if the heat anticipator is set correctly; and 5) clean the blower and fan blades. This is only a partial list of techniques that can improve furnace efficiency.

Operators who have less technical experience can: 1) clean or replace air filters; 2) shut off the pilot flame in the summer (re-ignition, however, should be undertaken by a suitably qualified person); 3) lubricate motors and bearings; 4) check all supply air and return air outlets to ensure they are free of obstructions; and 5) check all accessories and duct connections for separations and air leakage.

More complex adjustments and repairs may have to be done by specialists. A professional furnace tune-up every year will help maintain a comfortable building interior and save energy dollars through efficient furnace operation.

The Application...

Sunset Apartments is a 16-unit senior citizens' apartment complex in Calmar, Alberta. Built in 1985, the single-storey, wood-frame building has 12 540 square feet (1170 square metres) of floor area.

In June 1988, an Alberta Energy Bus team conducted an energy audit of the building. At the time, the furnace was operating at about 64 per cent efficiency. The audit team recommended improving the furnace efficiency to 75 per cent.

A follow-up check of the audit recommendations for improving furnace efficiency was made in June 1989. As a result of the furnace tune-up and other maintenance work done on the furnace, the steady-state efficiency increased to 75 per cent.

Based on the original energy audit and the follow-up check, the potential annual natural gas savings through improving furnace efficiency by about 11 per cent would be $296. Using an average furnace tune-up charge of $50, the payback period for the investment in the furnace tune-up would be only two months (cost of the tune-up, divided by the savings, multiplied by 12 months of the year).

A tune-up and other maintenance improved the Sunset Apartment's furnace efficiency by 11 per cent.

The Bottom Line...

Improving furnace efficiency can often be accomplished by relatively simple maintenance techniques. However, more complex work may have to be done by specialists. In Alberta, the cost of an average furnace tune-up (based on an industry survey) is $40 to $60; this does not include parts and additional repairs.

Industry sources and energy audit data indicate that, on average, there is good potential for at least 10 per cent improvement in furnace seasonal efficiency. If the servicing is done by regular maintenance staff, the savings are realized immediately. Hiring a specialist will have varying payback periods, depending on the cost of the work performed. Simple payback is calculated by dividing the cost of the furnace tune-up by the annual savings, multiplied by 12 months of the year.

For relatively minor service work, bigger furnaces, or those with a large annual fuel consumption, are likely to have a shorter payback period.

The accompanying graph shows the potential annual savings that could be expected from improving furnace efficiency by 10 per cent. To use the graph, building owners and operators need to know the natural gas rate (dollars per gigajoule [$/GJ]) and the size of the furnace (British thermal units per hour [Btu/hr]). To obtain the potential annual energy savings, locate the natural gas rate closest to your rate on the horizontal axis, then extend a vertical line up to the furnace output nearest to the size of your furnace. Reading across to the left will show the annual savings.

EXAMPLE

Natural gas price = $2.43/GJ

Furnace output = 180 000 Btu/hr.

Results from graph:
Annual savings = $44

In this case, the payback period for a $40 tune-up will be 11 months (40/44 × 12).

If the tune-up costs $60, the payback period will be 16.4 months (60/44 × 12).

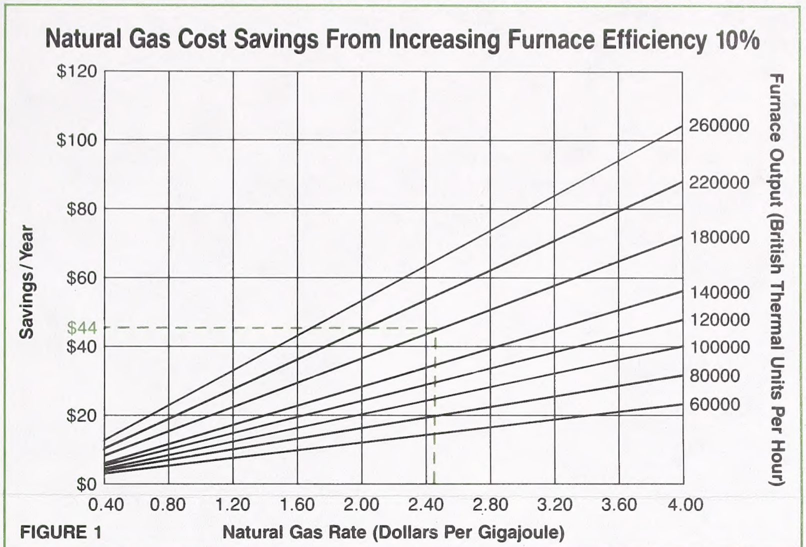


FIGURE 1

SECTOR REVIEW

Energy Use and Potential for Savings in Senior Citizen Residential Complexes

Energy use varies widely, depending on the type of building and the activities in the building. The extent of variation in energy use has become evident following Energy Bus audits of almost every type of facility in Alberta.

An energy audit determines how energy is being used and how much it costs in each area. Energy conservation measures are then identified which may result in energy cost savings. On average, the Energy Bus staff has identified a potential reduction in energy costs of about 20 per cent.

Energy audits of 51 senior citizen complexes throughout Alberta have identified good potential for lowering energy costs while maintaining a comfortable environment for residents. Energy audit data show that senior citizen complexes have the potential to save an average of $5400 a year, or a total of $275 400 a year for the 51 facilities. These savings represent 19 per cent of the total energy costs for the audited facilities.

Within this housing sector, annual energy bills ranged from $3500 to $160 000. The average yearly energy cost was about $28 500.

Figure 2 shows the relative percentage of natural gas and electrical energy use and cost in senior citizen complexes. Natural gas use is highest – 82 per cent compared with 18 per cent for electricity. However, the cost of natural gas used by the seniors' facilities accounts for only 44 per cent of the total energy costs. The difference in percentage of energy used and its cost is because the average price of a unit of electrical energy used within the senior citizen residential housing sector is 5½ to six times the equivalent unit of natural gas.

Figure 3 illustrates how natural gas and electricity are used in this housing sector. Improvement of combustion efficiency will result in energy cost savings relative to all areas of natural gas use.

Alberta Energy Bus audit data show that the potential annual energy cost savings for this sector ranged widely from about $81 per year to over $27 000. Only about 24 per cent of the identified energy dollar savings require measures that involve capital cost investments. Most of the identified savings can be generated by no-cost or low-cost measures that could be covered by a facility's operating and maintenance budget. Many of these energy-saving measures involve adjusting a control setting or making small changes in normal operating and maintenance procedures.

Combustion efficiency improvements are among the general maintenance measures that can result in worthwhile savings, while not affecting the comfort level of residents.

Energy Bus audits have identified a potential to improve combustion efficiency in 14 of the 51 audited senior citizen complexes. Of the total natural gas savings identified for the 51 facilities, the potential savings from improving combustion efficiency amounts to $6300 or 5.4 per cent (as shown in Figure 4).

The 14 facilities which were identified as having potential for combustion efficiency improvement were using 27 per cent of the total natural gas in the 51 audited facilities. As Figure 4 illustrates, the improvement in furnace efficiency would result in a 3.3 per cent saving of the total natural gas used by these 14 facilities.

Energy Use and Cost in Senior Citizen Complexes

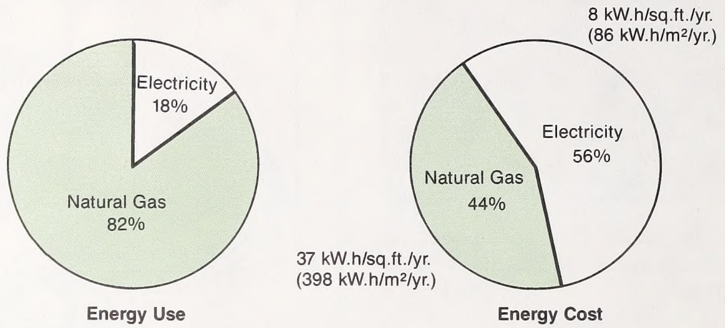


FIGURE 2

Energy Use in Senior Citizen Complexes

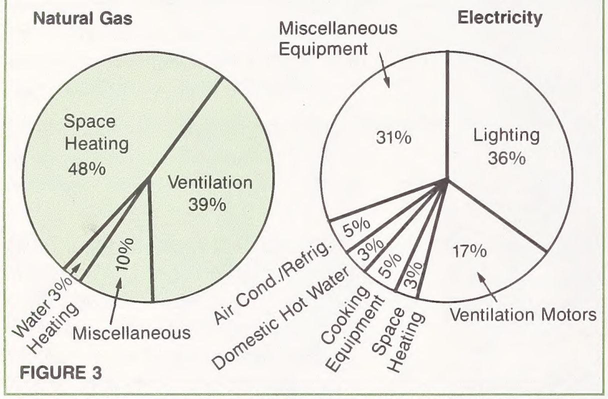


FIGURE 3

Combustion Efficiency Savings

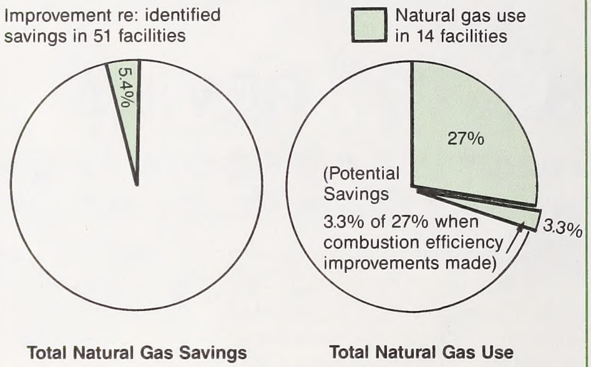
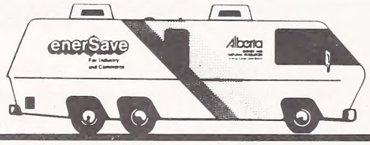


FIGURE 4

FOR MORE INFORMATION

The article Tune-Up Your Furnace And Save was researched by David Supruniuk and the Sector Review was completed by Les Sladen. For detailed information on energy cost saving calculations and the energy audit database, contact the industrial section of the Energy Efficiency Branch: Phone 427-5200 (collect).



ENERGY $AVER$

Energy $aver$ is a series of fact sheets about energy conservation measures that have wide application in Alberta. Each issue highlights a different technology and its successful use in the province. The Sector Review summarizes energy use patterns of different facilities that have used the Alberta Energy Bus audit service. Comments, questions and suggestions are welcome.

Write or phone (collect) to be placed on the mailing list. You may also obtain Energy $aver$ back issues or arrange for an Energy Bus audit (conducted at no charge).

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Pub. No. I/249 1989
ISBN 0-86499-5660

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Energy Efficiency Branch